Original Article

Predictability Of ANB, Beta And YEN Angles As Antero-Posterior Dysplasia Indicators In North Indian Population

Dr. Bilal Ahmad Bhat[1], Dr. Neha Agarwal[2], Dr. Sujit Panda[3], Dr. Karuna Singh Sawhny[4], Dr. Anany Omar[5], Dr. Nitish Pratap Singh[6]

[1]Post Graduate Student (Third Year), Department of Orthodontics and Dentofacial Orthopaedics, Rama Dental College Hospital and Research Centre, Kanpur, India
[2]Professor, Department of Orthodontics and Dentofacial Orthopaedics, Rama Dental College Hospital and Research Centre, Kanpur, India
[3]Professor and Head, Department of Orthodontics and Dentofacial Orthopaedics, Rama Dental College Hospital and Research Centre, Kanpur, India
[4]Professor, Department of Orthodontics and Dentofacial Orthopaedics, Rama Dental College Hospital and Research Centre, Kanpur, India
[5]Post Graduate Student (Third Year), Department of Orthodontics and Dentofacial Orthopaedics, Rama Dental College Hospital and Research Centre, Kanpur, India
[6]Post Graduate Student (Third Year), Department of Orthodontics and Dentofacial Orthopaedics, Rama Dental College Hospital and Research Centre, Kanpur, India

Corresponding Author: Dr. Bilal Ahmad Bhat
Post Graduate Student (Third Year), Department of Orthodontics and Dentofacial Orthopaedics, Rama Dental College Hospital and Research Centre, Kanpur, India
Email: bilal.ahmeddr118@gmail.com
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Abstract

Objective: The purpose of this study was to assess the predictability of ANB, Beta and YEN angle as antero-posterior dysplasia indicators in cases of skeletal Class II malocclusions in North Indian population.
Methods: 72 samples of lateral cephalograms were obtained from preexisting records form the Department of Orthodontics, Faculty of Dental Sciences, Rama University, Uttar Pradesh. The lateral cephalograms were of pretreatment skeletal Class II patients which were selected on the basis of Down's facial angle (<82°). The parameters were evaluated and the correlations as well as the variations between them were assessed.
Results: The correlations between ANB, Beta and YEN angles were found to be statistically significant, but only the correlation between ANB and YEN angle was found to be strong. Variations among these parameters exhibited YEN angle as the parameter with the least variation as compared to the ANB and Beta angle.
Conclusion: The YEN angle was found to be the most promising and reliable cephalometric parameter in the prediction of sagittal dysplasia, followed by the Beta angle and then the ANB angle.

Keywords: Cephalometrics, ANB, Beta, YEN angle, sagittal dysplasia

Introduction

The anterior surfaces of the patient's basal part of the jaws with the teeth in occlusion were palpated and an overall profile image of the patient was used to analyze the skeletal pattern.[1] Broadbent and Hofrath first presented cephalometrics in 1931. With the help of this technique, we may precisely assess the sagittal apical base connection.[2,3] Evaluation of the sagittal apical base connection has been given significant weight in orthodontic diagnosis and treatment planning. To help clinicians identify antero-posterior(AP) inconsistencies and determine the correct course of treatment, several cephalometric analyses have included both angular and linear measurements.[4,5] Class II skeletal malocclusion is characterized by maxillary protrusion, mandibular retrusion, or a combination of thetwo.[6] Down's description of points A and B served as the foundation for analyzing the antero-posterior jaw relationship cephalometrically.[6] A few years later, Riedel utilized angle ANB[7,8], which later developed into a crucial component of several analyses, including Steiner's analysis, and has since become the most often used measurement.[9,10] However, it has been asserted that the ANB angle is influenced by several deceptive elements and may produce incorrect results[11-15] as a result, numerous other measurements have been devised.[13,14] Later few pioneer workers have established the YEN angle without taking into account any reference planes. Points S, M (the middle of the anterior part of maxilla), and G. Mandible is categorized as either retrognathic or prognathic in light of this. A class II skeletal profile is indicated by a decreased facial angle, whereas a class III skeletal profile is indicated by an increased facial angle.[15] In cases of skeletal class II malocclusion in the North Indian population, the purpose of this study was to evaluate the predictability of ANB, Beta, and YEN angles as antero-posterior dysplasia indicators. In order to develop more precise predictor for evaluating sagittal discrepancies, this study looks at the variations and correlations between these characteristics.

Aims and Objectives

The aims and objectives of the study was :

1. To predict the reliability of ANB, Beta and YEN angles as an anteroposteriordysplasia indicator in North Indian Population.
2. To assess the variations as well as correlation between the parameters.

Materials and Methods

Materials required were Pre-treatment lateral cephalometric radiographs, Tracing paper, X-ray viewer, 3H pencil, Data recording sheets

Methodology

Pre-treatment lateral cephalometric radiographs of 72 skeletal class II malocclusion patients from the Department of Orthodontics and Dentofacial Orthopaedics Rama Dental College, Hospital and Research Centre in Kanpur were used in this retrospective study. The Down's facial angle (<82°) was used as the basis to select skeletal Class II radiography samples. With the use of an X-ray viewer, manual tracings were performed on acetate tracing paper with a 3H pencil. On the cephalograms that were traced, the landmarks were marked. On data recording sheets, measurements of the ANB, Beta, and YEN angles were made and recorded. Inclusion criteria were age group 18 to 25 years, no previous history of orthodontic treatment, No history of trauma, availability of good quality cephalometric radiographs. Exclusion criteria were subjects with congenital anomalies/ syndromes, subjects with marked asymmetries, Cephalometric parameters were Downs Facial angle (Figure-3), ANB (Figure-4), Beta angle (Figure-5), YEN angle (Figure-6).

Figure 1: Lateral cephalogram of subject

Figure 2: Armamentarium required for tracing of a lateral cephalogram

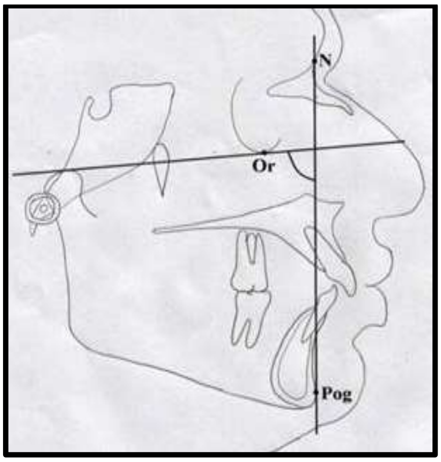


Figure 3: Downs' Facial angle. Landmarks depicted: N-Nasion, Or-Orbitale, Pog-Pogonion

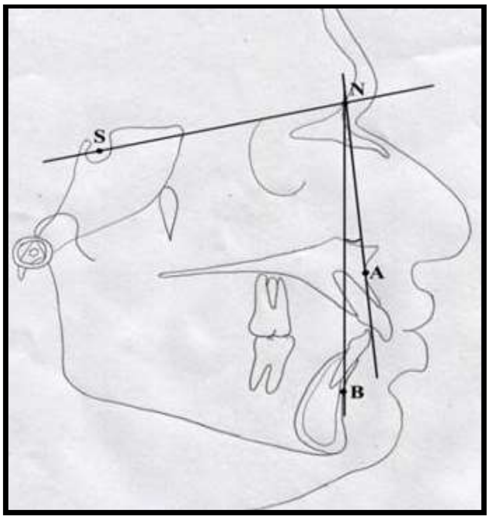


Figure 4: The ANB angle. Landmarks depicted: S-Sella, N-Nasion, A-Point A, B-Point B

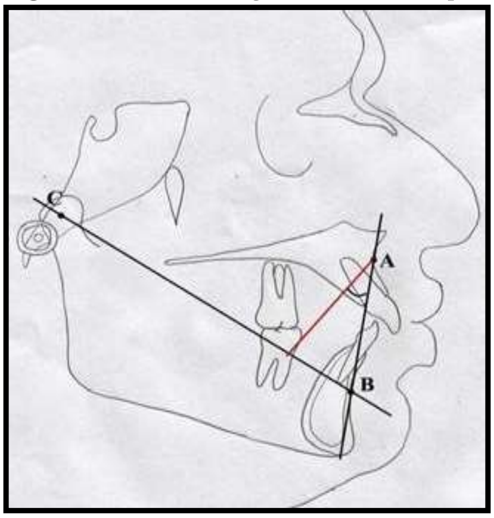


Figure 5: The Beta angle. Landmarks depicted: C-Condylion, A-Point A, B-Point B

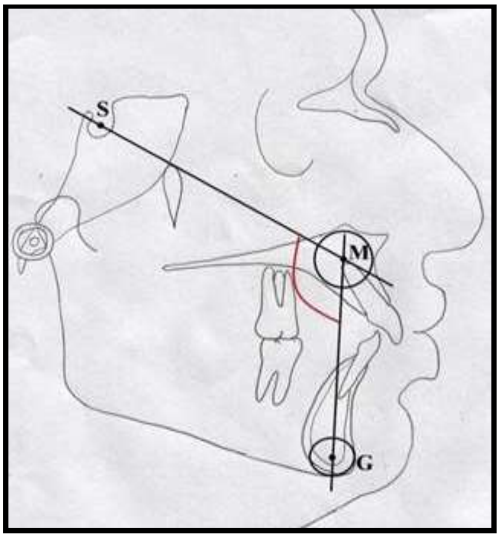


Figure 6: The YEN angle. Landmarks depicted: S-Sella, M-midpoint of premaxilla,G-center of mandibular symphysis

Observations and Results

The results were analyzed using descriptive statistics and making comparisons among the various groups. Discrete (categorical) data weresummarized as in proportions and percentages (%). The p-value was taken significant when less than 0.05 ($p<0.05$) and Confidenceinterval of 95% was taken. The measured ANB angle for all the cases of skeletal class II under study was foundto be within the standard range of class II (>2°). And so, it showed 100% accuracyfor measuring skeletal class II. The measured Beta angle for the cases of skeletal class II under study was found to bewithin the standard range of class II (< 27°) among 41 (56.9%) cases. And so it showed 56.9% accuracy for measuring skeletal class II (table 2). The measured YEN angle for the cases of skeletal class II under study was found tobe within the standard range of class II (< 117°) among 70 (97.2%) cases. And so it showed 97.2% accuracy for measuring skeletal class II (table 3). The measured ANB angle for the cases of skeletal class II under study had a mean±SD value of 6.47±2.13 which measures the coefficient of variation (CV) of 32.95 and standard error 0.25. That further estimated the predictive range for estimating skeletal class II as (2.26 – 10.68) (table 4). The correlation between ANB angle and Beta angle was found to be $r = -0.304$ (-ve), which was statistically significant ($p=0.009$), however it is not considered to bestrong (table 5). The correlation between ANB angle and Beta angle was found to be $r = -0.304$ (-ve),which was statistically significant ($p=0.009$), however it is not considered to be strong (table 6). The correlation between ANB angle and YEN angle was found to be $r = -0.616$ (-ve),which was statistically significant ($p<0.001$), and considered to be strong (table 7). Further the linear regression analysis generated the following equation for estimatingANB angle by the help of YEN angle, ANB angle = 37.56 – 0.28×YEN angle (Graph 2). The correlation between ANB angle and YEN angle was found to be $r = -0.616$ (-ve),which was statistically significant ($p<0.001$), and considered to be strong (table 8). The correlation between Beta angle and YEN angle was found to be $r = 0.328$ (+ve), which was statistically significant ($p=0.005$), however it is not considered to bestrong (table 9). The correlation between Beta angle and YEN angle was found to be $r = 0.328$ (+ve),which was statistically significant ($p=0.005$), however it is not considered to be strong (table 10).

Table–1: Prediction Accuracy of ANB Angle for skeletal class II by establishedrange

Estimated class byANB Angle	No.	%	% Accuracy
Class II	72	100.0	100

Table–2: Prediction Accuracy of Beta Angle for skeletal class II by establishedrange

Estimated class by Beta Angle	No.	%	% Accuracy
Class I	31	43.1	56.9
Class II	41	56.9	
Total	72	100.0	

Table–3: Prediction Accuracy of YEN Angle for skeletal class II by establishedrange

Estimated class by YEN Angle	No.	%	% Accuracy
Class I	2	2.8	97.2
Class II	70	97.2	
Total	72	100.0	

Table–4: Descriptive Summary and Prediction Range Estimation of ANB, Betaand YEN Angles for skeletal class II

Angle	Mean	SD	CV	SE	95% LPL	95% UPL
ANB Angle	6.47	2.13	32.95	0.25	2.26	10.68
Beta Angle	25.47	4.66	18.29	0.55	16.27	34.66
YEN Angle	109.89	4.65	4.23	0.55	100.72	119.06

Table–5: Correlation & Regression Analysis for estimating ANB Angle by Beta angle

Dependent: ANB Angle	B	SE	t-value	p-value	95% CIL	95% CIU	Pearson's Correlation	p-value
(Constant)	10.01	1.35	7.42	0.00	7.32	12.71	-0.304	**0.009**
Beta Angle	-0.14	0.05	-2.67	0.01	-0.24	-0.04		

Table–6: Correlation & Regression Analysis for estimating Beta Angle by ANBangle

Dependent: Beta Angle	B	SE	t-value	p-value	95% CIL	95% CIU	Pearson's Correlation	p-value
(Constant)	29.76	1.69	17.57	0.00	26.38	33.14	-0.304	**0.009**
ANB Angle	-0.66	0.25	-2.67	0.01	-1.16	-0.17		

Table–7: Correlation & Regression Analysis for estimating ANB Angle by YENangle

Dependent: ANB Angle	B	SE	t-value	p-value	95% CIL	95% CIU	Pearson's Correlation	p-value
(Constant)	37.56	4.75	7.91	0.00	28.08	47.04	-0.616	**<0.001**
YEN Angle	-0.28	0.04	-6.55	0.00	-0.37	-0.20		

Table–8: Correlation & Regression Analysis for estimating YEN Angle by ANBangle

Dependent: YEN Angle	B	SE	t-value	p-value	95% CIL	95% CIU	Pearson's Correlation	p-value
(Constant)	118.58	1.40	84.92	0.00	115.80	121.37	-0.616	**<0.001**
ANB Angle	-1.34	0.21	-6.55	0.00	-1.75	-0.93		

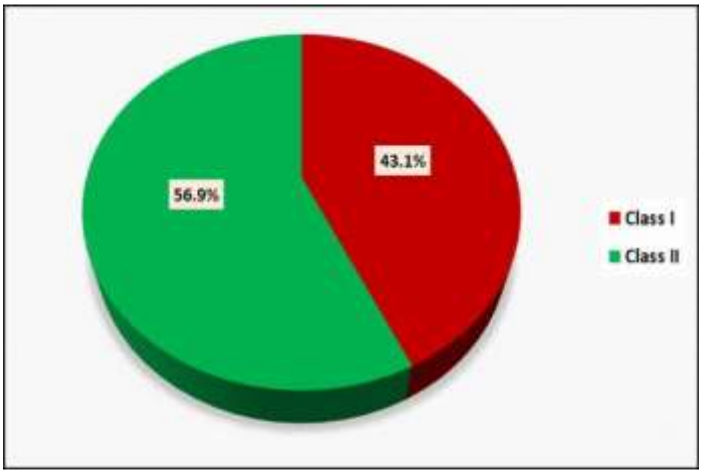
Table–9: Correlation & Regression Analysis for estimating Beta Angle by YEN angle

Dependent: Beta Angle	B	SE	t-value	p-value	95% CIL	95% CIU	Pearson's Correlation	p-value
(Constant)	-10.68	12.45	-0.86	0.39	-35.50	14.15	0.328	**0.005**
YEN Angle	0.33	0.11	2.91	0.00	0.10	0.55		

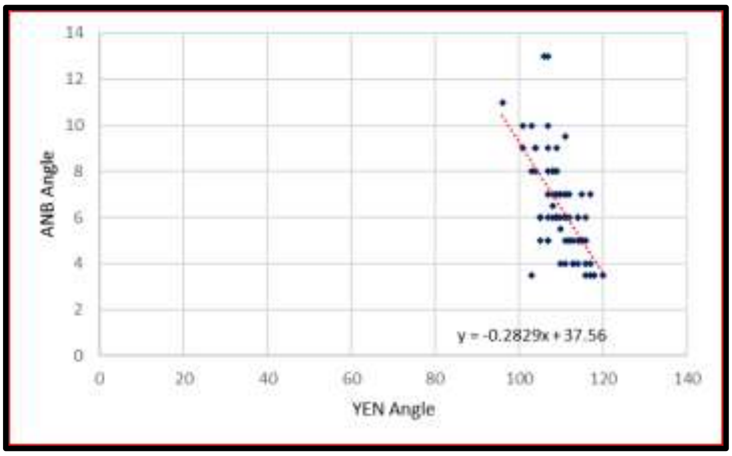
Table–10: Correlation & Regression Analysis for estimating YEN Angle byBeta angle

Dependent: YEN Angle	B	SE	t-value	p-value	95% CIL	95% CIU	Pearson's Correlation	p-value
(Constant)	101.55	2.92	34.84	0.00	95.74	107.37	0.328	**0.005**
Beta Angle	0.33	0.11	2.91	0.00	0.10	0.55		

Graph 1: Prediction Accuracy of Beta Angle for skeletal class II by established range



Graph 2: Correlation & Regression Analysis for estimating ANB Angle by YEN angle



Discussion

The Lateral Cephalometric Radiograph, which Broadbent introduced in 1931, is avery helpful diagnostic tool in orthodontic practice. In the year 1947, Wylie was the first to assess the maxilla-mandibular relationship in an antero-posterior plane, thereafter; a lot of analyses have been interposed to assess the same.[16--20] To analyze sagittal jaw relationship and jaw location in cephalometrics, both angular and linear variables have been proposed.[21-22] Changes in facial height, jaw inclination,and overall jaw prognathism can lead to inaccurate angular measurements; the inclination of the reference line can have an impact on linear variables. Many researchers have used lateral cephalometric radiographs tostudy dentofacial balance and harmony as well as growth and development in four dimensions, namely height, depth, breath, and time.[23,24] Analysis of the jaws in the sagittal plane is crucial because the majority of orthodontic issues arise in the anteroposterior plane. The present study was carried out to determine the predictability of ANB, Beta, and YEN angles in assessing sagittal discrepancy in class II malocclusion patients among the north Indian population. This study used statistical analysis. Prediction accuracy was one of those. In this statistical analysis, the measured ANB angle for all the cases of skeletal class IIunder study was found to be within the standard range of class II (>2°). And so, it showed 100% accuracy for measuring skeletal class II. The YEN angle was developed by Neela et al. as a new cephalometric measurement in the year 2009.[25] The present study showed that the Beta and YEN angle are positively correlated but the correlation is weak and considered not to be strong. This was also supported by Chandrika et al (2020) and Doshi et al (2011). The ANB and Beta angle also have a negative correlation, but (r) value being less makes it weakly correlated. This was supported by Gul-e-Erum and Mubassar Fida (2008)[28] who also found weak correlation between ANB and Beta angle. The negativecorrelation between the ANB and Beta angle is also in concordance to the study done by Chandrika et al (2020), Doshi et al (2011). The present study also illustrated that the ANB angle has a least efficacy as a true sagittal dysplasia predictor in class II patients as compared to other two parameters. This study is similar to the Chandrika et al (2020).[26] The present study showed that the Beta angle values were statistically significant which was supported by Chandrika et al (2020), Doshi et al (2012). In contrast to ANB angle, Beta angle is independent of cranial landmarks and remains stable even when the jaws are rotated, Because the C-B line rotates in the same direction as the jaw rotates and carries the perpendiculars from point A with it.[5] It is challenging to trace and identify the condyle's centre. On the other hand, Doshi et al (2012) showed a positive association between Beta angle and Frankfort-mandibular plane angle, showing the fluctuation that may occurin the angle during jaw rotations.[27] This claim was closely related to that made by Sundereshwaran et al,[29] who noted that clockwise rotation of the mandible had an impact on the reliability of the beta angle as an anteroposterior discrepancy. The measured YEN angle for the cases of skeletal class II under study had a mean± SD value of 109.89±4.65 which measures the coefficient of variation (CV) of 4.23 and standard error 0.55. That further estimated the predictive range for estimating skeletal class II as (100.72–119.06). The results of the present study illustrated that YEN angle was a better predictor for the class II sagittal discrepancy than ANB and Beta angles. Our study showed that the YEN angle values were statistically highly significant with the p-value (<0.001). In the present study, YEN angle showed least variation (CV) of 4.23 as compared to other two parameters namely ANB and Beta angles which revealed that YEN angle was found to be homogenously distributed parameter and thus showed least variations than the other two angular parameters. This study's findings agreed with those of Chandrika et al.[26] This study is also in concordance with the Doshi et al[27] and Venkata et Al.[30] The most often used measure for assessing the anteroposterior jaw relationship is still the ANB angle, however it is complicated by a number of factors. All those factors must be taken into account while using the ANB angle, which makes its interpretation significantly more difficult than previously imagined. The present study revealed mean value of 6.47±2.13 along with the coefficient of variation (CV) of 32.95 and standard error 0.25. The variation could be due to the ANB angle is influenced by variations in the horizontal or vertical position of nasion and Taylor's study illustrated that nasion was shifting away from sella approximately 1 mm per year.[5] Because of these intrinsic problems, ANB could often be a weak reflection of actual apical base relationship. Despite the fact that the WITS appraisal avoids nasion point and lessens the rotational effects of jaw growth, it employs the occlusal plane, a dental parameter to depict a skeletal maxillo-mandibular relation. The eruption of teeth and the growth of the dental arch affect the cant of the occlusal plane.[21] The present study revealed Beta angle to be more presumable and less variable than the ANB angle in diagnosing skeletal class II malocclusion and the result of the Beta angle values was supported by Baik and Ververidou,[3] Fida,[28] Qamruddin[31], Kannan[23], Sachdeva[24] all reported lower Beta angle variability. Doshi[27] observed that the beta angle was more accurate in class II patient diagnosis in the Indian population. Although Beta angle was found to be more presumable and less variable than ANB angle, but YEN angle was found to be the most presumable and least variable than Beta and ANB angles. Therefore, in individuals with vertical development patterns and skeletal class I and class II malocclusions, beta angle may not be the most accurate measurement for determining sagittal jaw discrepancy. This study concluded that YEN angle is the most promising cephalometrical sagittal dysplasia predictor; collaborating this with patient’s clinical findings helps in appropriate diagnosis of a case.

Conclusion

Based on the results of the present study, we concluded that; the YEN angle was found to be the least variant parameter among the ANBand Beta angles. Also, the correlation analysis was observed to be strong between

ANB and YENangles and was statistically significant among all the parameters. Additionally, the YEN angle was observed to be the most presumable and homogenousdysplasia indicator among the north Indian population. The ANB angle was also found to be the most variant and thus less presumable andtrue indicator. The YEN angle values that were obtained from the study can be implemented asthe dysplasia indicator in north Indian population.

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